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MEDICAL DIAGNOSIS
WITH ELECTRONIC COMPUTERS:
AN ANNOTATED BIBLIOGRAPHY

SPECIAL BIBLIOGRAPHY
SB-63-8

APRIL 1963

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**MEDICAL DIAGNOSIS
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Compiled by
Eugene E. Graziano

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WORK CARRIED OUT AS PART OF THE LOCKHEED INDEPENDENT RESEARCH PROGRAM

Lockheed

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SUNNYVALE, CALIFORNIA

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ABSTRACT

This bibliography consists of 125 references to sources on medical diagnosis with electronic computers, and selected related materials. Really definitive experiments have not been performed in this field, but a large number of pilot studies have generally led to the belief that automatic diagnosis by computers is feasible, necessary, and should be part of a comprehensive national medical data control system. A few items were not available for annotation.

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1. Almy, T.P.
Some comments on the usefulness of electronic data processing in medical practice. IRE TRANSACTIONS ON MEDICAL ELECTRONICS ME 7(4): 315-316, Oct 1960

Electronic data processing can relieve physicians of much activity, but the importance of listening, thinking, and reasoning, in the therapeutic situation, will not be diminished.

2. Amosov, N. M., and E. A. Shkabara
Experience in determining diagnosis with the aid of diagnostic machines. EKSP. KHIR. ANEST. 6: 15-22, July-Aug 1961. (Russian)

3. Amosov, N. M. and E. A. Shkabara
Solution of the problem of diagnosis by an electronic machine. AUTOMATIKA, No. 1, 47-55, 1961. (In Russian, English summary)

The "Ural" computer has been programmed to solve diagnostic problems. Symptoms of various diseases are checked on a relay machine, and algorithms have been compiled for the interpretation of electrocardiograms.

4. Arms, R. J.
Digital analysis of vector cardiographic readings.
In ANNUAL CONFERENCE ON ELECTRICAL TECHNIQUES IN MEDICINE AND BIOLOGY, 13th, Washington, D. C. Digest of Technical Papers, p.40. 31 Oct-2 Nov 1960.

5. Ax, Albert F.
Computers and Psychophysiology in Medical
Diagnosis. IRE TRANS. ON MED. ELECT.
ME 7(1): 263-264, Oct 1960.

29 physiological variables can be digitized, recorded, and correlated.

6. Barlow, John S.
Autocorrelation and Crosscorrelation Analysis
in Electroencephalography. IRE TRANS. MED. ELECT.
ME 6: 179-183, Sep 1959.

These two methods of EEG analysis are discussed in some detail, and examples are
given as obtained from especially designed semi-automatic computers.

7. Barlow, J. S.
An electronic method for detecting evoked responses
of the brain and for reproducing their average
wave-forms. ELECTROENCEPHALOG. AND CLIN.
NEUROPHYSIOL. 9: 340-343, 1957.

Description of a method for averaging wave-forms of electroencephalographs.

8. Baruch, Jordan J.
Doctor-Machine Symbiosis. IRE TRANSACTIONS
ON MEDICAL ELECTRONICS. Me 7(4): 290-293,
Oct 1960.

The best division of diagnostic tasks between physician and machine, and the problems
of communication are discussed.

9. Becker, David V.
Progress report on the New York center for
biomathematical research. IN PROC. 2ND
IBM MEDICAL SYMPOSIUM, Endicott, N. Y.,
Sep 28-30, 1960. 287-295.

A center is tentatively being organized that will bring together highly qualified biologists and mathematicians for promoting applications of computer and electronic sciences in medical and biological areas.

10. Beckett, Peter G. S.
Computers and Clinical Psychiatry. IRE
TRANSACTIONS ON MEDICAL ELECTRONICS.
ME 7(4): 248-250, Oct 1960.

Data obtained by psychiatrists in lengthy interviews should be recorded for high-speed processing. Experience in this task is discussed.

11. Bendat, Julius S.
Interpretation and Application of Statistical
Analysis for Random Physical Phenomena.
IRE TRANSACTIONS ON BIO-MEDICAL
ELECTRONICS. BME-9: 31-43, Jan 1962.

Mathematical and statistical concepts are presented for analyzing random physical phenomena in such diverse areas as vibration in space vehicles and biomedical research.

12. Berlin, M.M.
Computers in medicine: progress and potential.
COMPUTERS & AUTOMN. 11:32-36, Jul 1962.

A review of applications of electronic computers to problems of medical diagnosis.

13. Brandt, E. N. Jr., J. A. Hagans and
W. W. Schottstaedt
The computer as a diagnostic aid in medicine.
J. OKLA. MED. ASSOC. 55:213-217, May 1962.

14. Brannick, L. J.
An analog approach to computer diagnosis.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS.
ME7(4):247-248, Oct 1960.

A special purpose computer was used to match a set of symptoms with all diseases in the memory that exhibited the set. The degree of correlation was computed for each match.

15. Brazier, M. A. B., ed.
COMPUTER TECHNIQUES IN EEG ANALYSIS.
CONFERENCE SPONSORED BY THE BRAIN
RESEARCH INSTITUTE, UN. OF CALIF.,
LOS ANGELES, OCT 29-30, 1960. Amsterdam,
1961. (Electroencephalography and clinical
neurophysiology, Suppl. 20).

16. Brodman, K.
Diagnostic decisions by machine. IRE TRANS.
ON MED. ELECTRONICS ME-7:216-219, Jul 1960.

A data processing machine is used to diagnose, and in practice it made a correct diagnosis as often as a physician.

17. Brodman, K., et al.
Interpretation of symptoms with a data-processing
machine. A.M.A. ARCH. INT. MED. 103(5):776-782.
May 1959.

Report of experience with a high-speed electronic data-processing system which was
used to take reports of symptoms from patients, and to convert this data into a diagnosis.
The performance of the machine compared very favorably with that of a physician control.

18. Bruce, R. A., and A. R. Cox
Medical diagnosis by computer. NORTHWEST
MED. 60:1075-1082, Nov 1961.

A general statement of work in the area, and semi-technical presentation of a study
underway at the University of Washington.

19. Bykhovskii, M. L.
Cybernetics in medicine. Logics of probability
in the structure of auto-didactic diagnostic
processes in computers. EKSP. KHIR. ANEST.
7:3-11, Jan-Feb 1962. (In Russian)

20. Bykhovskii, M. L., A. A. Vishnevskii and
S. Sh. Kharnas
Problems in reasoning the diagnostic process with
the aid of mathematical machines. EKSP. KHIR.
ANEST. 6:3-15, Jul-Aug 1961. (In Russian)

21. Caceres, C. A.
How can the waveforms of a clinical electro-
cardiogram be measured automatically by a
computer? IRE TRANS. BIO-MEDICAL
ELECTRONICS BME-9:21-22, Jan 1962.

Classifications to be used by machines to interpret electrocardiograms should be developed by the clinician.

22. Caceres, C. A.
Observer instruments and computers in heart
disease control and as diagnostic aids. In
SECOND IBM MEDICAL SYMPOSIUM, ENDICOTT,
N. Y., SEP 28-30, 1960. p.365-378.

The use of electronic computers in the medical field is illustrated specifically with regard to the relationship of coronary disease to diet and to other variables that are believed to correlate with it.

23. Caceres, C. A. and A. E. Rikli
The digital computer as an aid in the diagnosis of
cardiovascular disease. TRANS. N. Y. ACAD.
SCI. 23:240-245, Dec 1960.

A general discussion of experience with, and the outlook for applications of computers to diagnostics.

24. Caceres, C. A., et al.
Computer extraction of electrocardiographic
parameters. CIRCULATION 25:356-362,
Feb 1962.

Description of a model study for extracting the significant electronic signals from more general data to determine the presence of disease.

25. Carberry, W. J.
AUTOMATIC METHODS FOR THE ANALYSIS
OF PHYSIOLOGICAL DATA. (Paper presented
at 31st Annual Meeting, Aerospace Med. Assoc.,
Miami, Fla., May 1960).

26. Clark, W. A., et al.
The average response computer (ARC): a digital
device for computing averages and amplitude and
time histograms of electrophysiological response.
IRE TRANSACTIONS ON BIO-MEDICAL ELEC-
TRONICS BME-8:46-51, Jan 1961.

The average response computer is a valuable tool in the statistical measurement of
neuroelectric activity. Its ability to change parameters during experiment, on the
basis of data obtained, is particularly useful.

27. Computer helps physicians diagnose. DATA
PROCESS. 3:21-23, 1961.

Popular treatment of an attempt to use computers in the correlation of data relating
to heart and vascular disease.

28. Conference on diagnostic data processing,
Proceedings. New York, 14 Jan 1959.
IRE TRANS. ON MED. ELECTRONICS. --
ME-7(4):232-317, Oct 1960.

A number of papers on the subject. Selected individual papers are listed under author.

29. Crooks, J., I. P. C. Murray and
E. J. Wayne
Statistical methods applied to the clinical
diagnosis of thyrotoxicosis. Q. J. MED.
28:211-234, 1959.

30. Crumb, C. B. and C. E. Rupe
The automatic digital computer as an aid in
medical diagnosis. In EASTERN JOINT
COMPUTER CONFERENCE, BOSTON, MASS.,
1-3 DEC 1959. PROCEEDINGS (Sponsored by
I.R.E., A.I.E.E., and A.C.M.). N. Y.,
1959. p.174-180.

Doctors are frequently able to assign sets of symptoms to correct categories, but have difficulty in making definitive diagnoses. A statistical correlation technique is proposed to assist in such cases.

31. DeCote, R. and W. J. Horvath
An electronic computer for vector electrocardiography.
IRE TRANS. ON MED. ELECT. PGME-8:31-37,
Jul 1957.

Description of a computer which was used to analyze a large body of data relating to electrocardiography.

32. Dunn, H. L.
Electronic data processing of national vital
statistics. IRE TRANSACTIONS ON MEDICAL
ELECTRONICS ME-7(4):295, Oct 1960.

Examination of electronic data processing procedures currently in use at the national office of vital statistics.

33. Ebald, R. and R. Lane
Digital computers and medical logic. IRE TRANS.
ON MEDICAL ELECT. ME-7(4):283-288,
Oct 1960.

On the algorithm for analysis of symptoms from clinical cases as compared to "classical" descriptions of hematological diseases.

34. Eden, M.
Storage and retrieval of the results of clinical
research. IRE TRANSACTIONS ON MEDICAL
ELECTRONICS ME-7(4):265-268, Oct 1960.

Structural linguistics' methods are applied to the problems of indexing, abstracting,
and retrieval of clinical data.

35. Farley, B. G., et al.
Computer techniques for the study of patterns
in the electroencephalogram. IRE TRANS.
BIO-MEDICAL ELECTRONICS BME-9:4-12,
Jan 1962.

On procedures using the TX-10 computer for the analysis of EEG patterns relating to
various states of the same individual.

36. Farley, B. G., et al.
COMPUTER TECHNIQUES FOR THE STUDY
OF PATTERNS IN THE ELECTROENCE-
PHALOGRAM. Lincoln Lab., M.I.T.
Technical rept. no. 165, 6 Nov 1957. 21p.
PB150607. ASTIA AD-11027.

Apparently an earlier version of item 35 in this bibliography.

37. Farrar, J. T.
Use of a digital computer in the analysis of
intestinal motility records. IRE TRANS-
ACTIONS ON MEDICAL ELECTRONICS
ME-7(4):259-263, Oct 1960.

Waveforms of intestinal motility have been converted to digital form and analyzed by
the Whirlwind I digital computer at M.I.T.

38. Forsythe, G. E., J. von der Groeben, and J. G. Toole
VECTORCARDIOGRAPHIC DIAGNOSIS WITH THE AID OF ALGOL. Applied Mathematics and Statistics Lab., Stanford U., Calif.
Technical rept. no. 16, 8 Oct 1961. 18p.
(Contract Nonr-22537; proj. NR. 044-211).
ASTIA AD-270 238.
39. Forsythe, G. E., J. von der Groeben, and J. G. Toole
Vectorcardiographic diagnosis with the aid of ALGOL. COMMUN. ACM 5:118-122, Feb 1962.

Description of a program to transform vectorcardiographic data from cartesian coordinates to spherical coordinates, and plotting against time.

40. Frankovskaia, V. G.
The problem of mechanization of work in the diagnosis and therapy of patients. SOVET ZDRAVOOKHR 20(8):39-43, 1961.
(In Russian)
41. Fry, D. L.
The use of computers in physiologic diagnosis.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):269, Oct 1960.

Mathematical models are established for cardiovascular and pulmonary systems from which are derived descriptive equations. Such equations are of potential diagnostic value, and examples are given.

42. Gillon, J. J.
Is automatic diagnosis in the future? CONCOURS
MED. 84:3829-3833, 23 Jun 1962.

A very brief critical survey of activities in automatic diagnosis.

43. Glaser, E. M.
An automatic system for processing microelectrode
data. IRE TRANSACTIONS ON BIO-MEDICAL
ELECTRONICS BME-9:190-194, Jul 1962.

Microelectrode data is converted into punched paper tape with time sequence preserved.
The data in this form is easily adapted to analysis by a number of different machines.

44. Greko, B.
Computer analysis of medical history as an aid
to diagnosis. BIT 2(1):9-15, 1962.

Presentation of the Swedish system MEDSAC for health screening of large numbers of
patients. A health questionnaire is completed by the patient, and analyzed by computer
which is capable of identifying 80 diseases.

45. Hayne, R. L. and J. F. Balthaser
The evaluation of clinical data with the IBM 101.
MED. DOKUM. 4:61-68, Jul 1960.
(In German)

46. High-speed computer to analyze human heartbeat.
N.B.S. TECHNICAL NEWS BULL. 43:196-197,
Oct 1959.

Brief note on a system for converting electrocardiograms from magnetic tape to
digital form.

47. Jonnard, R.
Random selection system for automatic
biochemical analysis -- partial functional
analysis. IRE TRANSACTIONS ON BIO-
MEDICAL ELECTRONICS BME-8:83-98,
Jan 1961.

The system performs the many activities required for the automatic biochemical
analysis of many body substances.

48. Jung, F. T.
Two important statistical devices. ARCH.
PHYS. MED. 33:711-720, Dec 1952. Correction
34:187, Mar 1953.

Presentation of the TEST-RETEST (rank difference) and FOURFOLD TABLE statistical
methods for use in diagnosis and therapeutics, respectively.

49. Kelly, W. A.
Possible application of EDP in daily practice.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):314, Oct 1960.

Electronic data processing can assist in the organization of medical data for better
diagnosis, testing, and therapy. It will also make study of great numbers of cases
possible.

50. Kornfeld, H.
Machine diagnosis: European experiences.
DEUTSCH MED. J. 12:642-645, 5 Nov 1961.
(In German)

A brief survey of activities in automatic diagnosis in Europe.

51. Kulikov, M. A.
Using the method of conditioned probabilities for
establishing a medical diagnosis. AUTOMATKA
5:13-19, 1961. (In Russian English summary)

Diagnosis based upon the use of conditioned probabilities of diseases where definite symptoms are present. Suitable for use with electronic computers.

52. Ledley, R. S.
Introduction to digital computers and automatic
programming. IRE TRANSACTIONS ON BIO-
MEDICAL ELECTRONICS. BME-8:158-167,
Jul 1961.

Discusses machine languages and programming languages, and how they can assist in biomedical research.

53. Ledley, R. S.
Using electronic computers in medical diagnosis.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):274-280, Oct 1960.

In applying electronic computers, logic, probability, and value theory must be understood as these disciplines operate in the diagnostic process.

54. Ledley, R. S. and L. B. Lusted
Computers in medical data processing.
OPERATIONS RES. 8(3):299-310,
May-Jun 1960.

The advantages and needs for a "national health computer network" are expounded. The methods of analysis for diagnosis are presented.

55. Ledley, R. S. and L. B. Lusted
Reasoning foundations of medical diagnosis;
symbolic logic, probability, and value theory
aid our understanding of how physicians reason.
SCIENCE 130(3366):9-21, 3 Jul 1959.

Symbolic logic, probability, and value theory are applied to demonstrate how physicians reason.

56. Ledley, R. S. and L. B. Lusted
The role of computers in medical diagnosis.
MED. DOKUM. 5:70-78, Jul 1961.

57. Ledley, R. S. and L. B. Lusted
The use of electronic computers in medical
data processing: aids in diagnosis, current
information retrieval, and medical record
keeping. IRE TRANSACTIONS ON MEDICAL
ELECTRONICS ME-7(1):31-47, Jan 1960.

Quantitative methods; progressing analysis in diagnosis and prognosis; and current information retrieval are potential contributions of computer aids in medical data processing.

58. Ledley, R. S. and L. B. Lusted
The use of electronic computers to aid medical
diagnosis. PROC. IRE 47:1970-1977, Nov 1959.

Several mathematical techniques can be applied to problems of automatic diagnosis. These are presented with discussion.

59. Levendel, L. and I. Fenyo
Electroclassifier; an instrument for solving
complex problems in diagnostic classification.
ORV. HETIL. 102:307-310, 12 Feb 1961.
(In Hungarian)

60. Lipkin, M.
Correlation of data with a digital computer in
the differential diagnosis of hematological
diseases. IRE TRANS. ON MED. ELECT.
ME-7(4):243-246, Oct 1960.

Hospital data relating to hematological diseases was tabulated, and examined to learn
if it normally suffices to establish diagnosis.

61. Lipkin, M., et al.
Digital computer as aid to differential diagnosis.
ARCHIVES INTERNAL MED. 108:56-72, Jul 1961.

Results of a study on medical data storage, retrieval, and analysis.

62. Lipkin, M. and J. D. Hardy
Mechanical correlation of data in differential
diagnosis of hematological diseases. AMER.
MED. ASSOC. J. 166:113-125, 11 Jan 1958.

A complete system is described which performed excellently in the differential diagnosis
of hematological diseases.

63. Lusted, L. B.
Computer programming of diagnostic tests.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):255-258, Oct 1960.

Consideration of the determination of the minimum number of tests necessary for the
diagnosis of a specific case.

64. Lusted, L. B.
Data handling, computers and diagnosis.
PROC. IRE 50:1190-1194, May 1962.

Both analog and digital computers are needed for progress in biomedical research. Biomedical personnel must be trained in computer techniques, experimentation, and have access to computing centers as aids to diagnosis.

65. Lusted, L. B.
Diagnostic video data processing. IRE TRANS.
ON MED. ELECT. ME-7(4):295, Oct 1960.

Computers are described that are capable of sorting abnormal from normal chest x-ray films.

66. Lusted, L. B. and R. S. Ledley
Mathematical models in medical diagnosis.
J. MED. EDUCATION 35:214-220, 1960.

Models from symbolic logic, probability, and value theory must be developed and taught in the U.S.A. Sample models are presented demonstrating each of the three methods.

67. McFee, R., A. Parungao and W. Mueller
An electronic coordinate transformer for
electrocardiography. IRE TRANSACTIONS ON
BIO-MEDICAL ELECTRONICS BME-8:52-54,
Jan 1961.

The transformation of ECG data from one set of coordinates to another frequently aids in diagnosis. An electronic instrument that will perform such transformations is described.

68. Machines for data processing in the service of medical science. (Les machines a traiter de l'information au service de la science medicale).
ELECTRO CALCUL 4:19-26, Jan-Feb 1962.
(In French)

Discusses preparation of indexes; applications of computers in diagnosis in France; and experience with automatic evaluation of electroencephalograms.

69. Mason, E. E., F. Chernigoy and B. Cusminsky
Computer analysis in development of new diagnostic methods. Urinary enzyme excretion. AMER.
MED. ASSOC. J. 178:1088-1090, 16 Dec 1961.

Experimental results are presented in general terms on the use computers to derive equations for logically combining the variables of symptomology and to produce a diagnosis.

70. Meneely, G. R.
Some reflections on medical diagnosis by electronic data processing machines. IRE TRANSACTIONS ON MEDICAL ELECTRONICS ME-7(4):309-319,
Oct 1960.

Report on a feasibility study for diagnosis with electronic computers conducted at Vanderbilt University School of Medicine. Conclusion that it is feasible and required.

71. Mildner, W. and W. Ameling
Analysing biological multi-compartment systems with the electronic analogue computer. (Analyse biologischer mehrkammersysteme mit dem elektronischen analogrechner). ELEKTRONISCHE DATENVERARBEITUNG 2:82-89, 1961.
(In German)

Simulations on analog computers are given of biological compartment systems.

72. Moyer, D. F. and G. D. Talbott
Instrumentation for the diagnosis of coronary-
artery disease. COMMUNICATIONS AND
ELECTRONICS 58:717-721, Jan 1962.

Description of the use of instrumentation to predict sclerosis by analysing the sounds produced by the flow of blood through arteries.

73. Nash, F. A.
Differential diagnosis, an apparatus to assist
the logical faculties. LANCET 266(6817):874-875,
24 Apr 1954.

Description of a simple mechanical device for aiding in diagnosis.

74. Nash, F. A.
The mechanical conservation of experience,
especially in medicine. IRE TRANSACTIONS
ON MEDICAL ELECTRONICS ME-7(4):240-243,
Oct 1960.

A "Grouped Symbol Associator" is suggested as the best machine for organizing and storing medical data, and for relating the particular case to the generalized description of the disease.

75. Office of Technical Services, Washington, D. C.
COMPUTER RESEARCH: MEDICINE, HUMAN
ENGINEERING, AND LEARNING MACHINES.
Rept. no. OTS SB-473. Aug 1961. 14p.

A bibliography of 137 items on biological applications of computers.

76. Overall, J. E. and C. M. Williams
Models for medical diagnosis. BEHAV. SCI.
6:134-141, Apr 1961.

Suggestions of models for simplifying decision processes in medical diagnosis so that a statistical approach may be used.

77. Overall, J. E. and C. M. Williams
Models for medical diagnosis: factor
analysis, I. Theoretical. MED. DOKUM.
5:51-56, Apr 1962.

78. Overall, J. E. and C. M. Williams
Models for medical diagnosis: factor
analysis, II. Experimental. MED. DOKUM.
5:78-80, Jul 1961.

79. Pace, W. H.
An analog computer model for the study of water
and electrolyte flows in the extracellular and
intracellular fluids. IRE TRANS. BIO-MEDICAL
ELECTRONICS BME-8:29-33, Jan 1961.

May be used to simulate the flow of extracellular and intracellular fluids in diseased conditions.

80. Paycha, F.
Diagnosis, therapeutics, prognosis, and computers.
IRE TRANS. ON MEDICAL ELECT. ME-7(4):
288-290, Oct 1960.

Review of the logical structure of medicine, and the applications of computers.

81. Paycha, F.
Medical diagnosis and cybernetics.
In MECHANISATION OF THOUGHT PROCESSES;
PROCEEDINGS OF A SYMPOSIUM HELD AT THE
NATIONAL PHYSICAL LABORATORY, [Teddington,
Eng.] ON NOV 24-26, 1958. London, H. M.
Stationary Off., 1959. v.2, p.635-667.
(Its Symposium no. 10).

The logic of medical diagnosis is analysed, and the advantages of using data processing machines are given.

82. Pepper, W.
A computer for a blood cell scanner. COMPUTERS
AND AUTOMN. 10:20-21, Nov 1961.

Brief description of a computer for analyzing leucocyte patterns automatically.

83. Pipberger, H. V. and E. D. Freis
Automatic analysis of cardiological analogue data
by means of electronic computers. MED. DOKUM.
4:58-61, Jul 1960. (In German)

84. Pipberger, H. V. and F. W. Stallmann
Use of a computer in ECG interpretation.
AMERICAN HEART JOURNAL 64:285-286,
Aug 1962.

Description of a series of programs for automatic analysis of ECG data by computer.

85. Pipberger, H. V., et al.
Preparation of electrocardiographic data
for analysis by digital electronic computer.
CIRCULATION 21:413-418, 1960.

A method is described for converting waveforms from analog to digital form for further processing and analysis.

86. Pircher, F. J., et al.
The Orins linear scanner in clinical diagnosis.
J. NUCL. MED. 3:26-40, Jan 1962.

87. Richards, R. S.
Analysis of heart murmurs by electronics.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
PGME-12:72-75, Dec 1958.

A survey of work on the diagnosis of abnormal heart conditions by use of audio-frequency amplifiers equipped with filters.

88. Rejlant, P.
Analysis of scalar and vector cardiograms with
an analog computer. Absolute values and
directing cosines of the vectors. BULL. ACAD.
ROY. MED. BELG. 2:363-391, 1962.
(In French)

89. Rikli, A. E. and C. A. Caceres
The use of computers by physicians as a diagnostic
aid. TRANS. N.Y. ACAD. SCI. 23:237-239,
Dec 1960.

A very brief discussion of the plausibility of using computers in diagnosis.

90. Rikli, A. E., et al.
Computer analysis of electrocardiographic
measurements. CIRCULATION 24:643-649,
Sep 1961.

ECG data is particularly suitable for computer analysis. This paper shows that even by using only one standard lead, it is possible by computer analysis to separate electrocardiograms into significant groups.

91. Roach, C. J., M. H. Ellestad and R. B. Lake
Medical data processing and computer automated
hospitals. DATAMATION 8:25-28, Jun 1962.

On the storage, retrieval, and handling of medical data by computers in hospitals.

92. Rockoff, M. L.
Diagnostic aspects of computer applications in
medical research at the University of Pennsylvania.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):250-252, Oct 1960.

Various mathematical techniques are correlated with different diagnostic implications relative to the utilization of computers.

93. Rodin, E., P. Beckett and S. Sokolov
A coding system for patients with convulsive
disorders and children with behavior disturbances.
IRE TRANS. BIO-MEDICAL ELECTRONICS
BME-9:61-64, Jan 1962.

A standard code sheet is presented for systematizing data taking on patients with convulsive and behavior disorders for processing with computers.

94. Schenthal, J. E.
Clinical concepts in the application of large scale
electronic data processing. In PROC. 2ND IBM
MEDICAL SYMPOSIUM, ENDICOTT, N. Y.
SEP 28-30, 1960. p.391-399.

Describes a pilot study on use of magnetic storage equipment and electronic data processing of medical data.

95. Schenthal, J. E., J. W. Sweeney and
W. Nettleton, Jr.
Clinical application of large-scale electronic
data processing apparatus. I. New concepts
in clinical use of the electronic digital computer.
AMER. MED. ASSOC. J. 173:6-11, 7 May 1960.

Description of a computer method for storing individual case histories so that data may be recalled in many different forms to meet future requirements.

96. Schweisheimer, W.
Can electronic machines facilitate and improve
medical diagnosis? HIPPOKRATES 33:162-167,
28 Feb 1962. (In German)

A general review on recent activities in this area.

97. Schweisheimer, W.
Robot diagnosis: AMERICAN experiences.
DEUTSCH MED. J. 12:639-642, 5 Nov 1961.
(In German)

A brief general survey of activities in automatic diagnosis in the U.S.A.

98. Schwichtenberg, A. H.
The development and use of medical machine record cards in the astronaut selection program. In PROC. 1ST IBM MEDICAL SYMPOSIUM, POUGHKEEPSIE, N. Y., JUN 15-17, 1959. p.185-216.

Description of the development of a set of 34 IBM cards to record the medical history of candidates for the astronaut program.

99. Silink, K.
The possibility of designing machines which learn diagnostic. The zero-systems of types and pathotypes in endocrinology. ACTIV. NERV. SUP. (Praha) 3:148-153, May 1961.

100. Smith, E. C., Jr.
Data processing considerations in the handling of medical data. IRE TRANSACTIONS ON MEDICAL ELECTRONICS ME-7(4):359-362, Oct 1962.

A general paper on the problems of medical data processing by computers, and the relationships of such data handling procedures to various areas of medicine, such as diagnostics.

101. Smith, P. A.
Some problems and approaches to automation of medical diagnosis. BEHAVIORAL SCIENCE 6:88-91, Jan 1961.

A review of possibilities for using computers to aid in diagnostic and other medical problems.

102. Spencer, W. A. and C. Vallbona
Digitation of clinical and research data in
serial evaluation of disease processes.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):296-308, Oct 1960.

On the quantification of disease phenomena for better diagnosis and therapy.

103. Stacy, R. W.
Diagnosis of arterial disease with analog computers.
IRE TRANS. ON MEDICAL ELECT. ME-7(1):269,
Oct 1960.

Arterial pulse waves are simulated and analyzed by computer.

104. Steinberg, C. A., S. Abraham and C. A. Caceres
Pattern recognition in the clinical electrocardiogram.
IRE TRANS. BIO-MEDICAL ELECTRONICS
BME-9:23-30, Jan 1962.

A feasibility study for the automatic analysis of ECG waveforms, and classification into
normal and abnormal categories.

105. Steinberg, C. A., et al.
Techniques for the use of the digital computer as
an aid in the diagnosis of heart disease. In
COMPUTERS-KEY TO TOTAL SYSTEMS CONTROL:
PROCEEDINGS OF THE 1961 EASTERN JOINT
COMPUTER CONFERENCE, WASHINGTON, D. C.,
12-14 DEC 1961. N. Y., 1961. p.371-380.

A very comprehensive report on the use of general purpose digital computers for
analysis of physiological waveforms for the diagnosis of cardio-vascular pathology.

106. Storm Van Leeuwen, W. and O. Magnus
The significance of automatic analysis of the
electroencephalogram for clinical diagnosis.
REV. NEUROL. (Paris) 104:177-203,
Mar 1961. (In French)

A very technical article on experience with the automatic analysis of electroencephalograms for diagnostic purposes.

107. Swenson, W. M.
A preliminary investigation of possibilities of
application of computer devices to the scoring
and interpretation of structured personality
tests and their use in a medical center. In
PROC. 2ND IBM MEDICAL SYMPOSIUM,
ENDICOTT, N. Y. SEP 28-30, 1960.
p.401-415.

Report of a machine method to interpret results of the Minnesota Multiphasic Personality Inventory test.

108. Taback, L.
ANALOG-DIGITAL CONVERSION EQUIPMENT
FOR ELECTROCARDIOGRAPHIC DATA.
National Bureau Standards, Washington, D. C.
Technical note 42, Apr 1960. PB151401.

Report of a pilot study for automatically analyzing electrocardiographic cycles.

109. Taback, L., et al.
Digital recording of electrocardiographic data
for analysis by a digital computer. IRE TRANS.
ON MED. ELECT. ME-6:167-171, Sep 1959.

Evidently a report on the same activities as are described in item 108.

110. Tanimoto, T.
IBM type 704 medical diagnosis program.
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):280-283, Oct 1960.

Presentation of a program for automatic diagnosis by simply putting into the machine information as to the presence or absence of symptoms. The mathematical model involved is described in some detail.

111. Taylor, R.
Major problems in the use of computing machines
IRE TRANSACTIONS ON MEDICAL ELECTRONICS
ME-7(4):253-254, Oct 1960.

Points up the problems associated with the practical utilization of computer methods in clinical situations.

112. Thomsen, D. L., Jr.
IBM's program for medical data processing.
In PROC. 1ST IBM MEDICAL SYMPOSIUM,
POUGHKEEPSIE, N. Y., JUN 15-17, 1959.
p.1-5.

A survey of IBM efforts that would tie-in with medical applications of electronic computers.

113. Tiffany, P. C.
The storage and retrieval of physiological and
medical data in a modern hospital. In PROC.
1962 SPRING JOINT COMPUTER CONFERENCE,
SAN FRANCISCO, 1-3 MAY 1962. American
Federation of Information Processing Societies,
1962. p.291-305.

Problems of medical data storage and retrieval and analysis are considered.

114. Tolles, W. E., C. A. Steinberg and W. J. Carbery
Experimental techniques and results of a study using
a computer as a diagnostic aid. TRANS. N. Y.
ACAD. SCI. 23:246-258, Dec 1960.

A detailed presentation of an experiment that attempted to use computers in the diagnosis of disease.

115. Vandenberg, S. G.
Medical diagnosis by computer: recent attempts and
outlook for the future. BEHAVIORAL SCIENCE
5:170-174, Apr 1960.

Three approaches to diagnostics by computer are defined: statistical, simulation, and logical. A possible fourth approach is discussed.

116. Vandenberg, S. G.
Medical diagnosis by computer: recent efforts and
outlook. COMPUTERS AND AUTOMATION
9(2 & 2F) -14, Feb 1960.

Very nearly the same as item 115.

117. Van Woerkom, A. J.
Program for a diagnostic model. IRE TRANS.
ON MED. ELECTRONICS ME-7:220, Jul 1960.

A program is briefly described that will diagnose diseases from the responses of patients to a 195-item standard medical-health questionnaire.

118. Visnevskij, A. A., M. L. Bychovsky and
S. S. Charnas
On the possible use of computing machines for
diagnostic purposes. CAS. LEK. CESK.
100:385-389, 31 Mar 1961. (In Czech)

119. Walsh, J. E.
Analyzing medical data -- some statistical considerations. IRE TRANSACTIONS ON MEDICAL ELECTRONICS ME-7(4):362-366, Oct 1960.

A general discussion of the variable nature of medical data, and the need to standardize for optimum use of statistical methods.

120. Ward, J. H. and M. E. Hook
Use of regression analysis and electronic computers in the prediction of coronary artery disease. BEHAVIORAL SCIENCE 7:120-126, Jan 1962.

An iterative method for multiple regression analysis by computer, of data for the indication of presence or absence of coronary heart disease.

121. Warner, H. R., et al.
A mathematical approach to medical diagnosis. Application to congenital heart disease. AMER. MED. ASSOC. J. 177:177-183, 22 Jul 1961.

An equation is given relating to conditional probability that expresses the logical process involved in making a diagnosis. Examples are given, and it is shown that this method is suitable for use with computers.

122. Weinrauch, H. and A. W. Hetherington
Computers in medicine and biology. AMER. MED. ASSOC. J. 169(3):240-245, 1959.

A general discussion of possibilities in the application of computers to problems of medicine and biology.

123. Young, T. Y.
 REPRESENTATION AND ANALYSIS OF
 SIGNALS. PART X. SIGNAL THEORY AND
 ELECTROCARDIOGRAPHY. John Hopkins
 U. School of Engineering, Baltimore, Md.
 15 May 1962. 112p. [Contracts Nonr-24853
 and AF 19(604)1941]. ASTIA AD-277 015.

Demonstration that some signal theory concepts are applicable to and greatly facilitate the digital-computer diagnosis of electrocardiograms. The two problems involved are: the representation problem and the classification problem. Numerous statistical methods are applicable to the classification problem; however, without an efficient representation, the great amount of work involved in the statistical calculation is prohibitive. The efficient representation of ECGs is indispensable and orthonormal exponential functions are very adequate for this purpose.

124. Zimmer, H.
 Preparing psychophysiologic analog information
 for the digital computer. BEHAVIORAL SCI.
 6(2):161-164, Apr 1961.

A number of physiological signals are considered for recording and analytical techniques by computer.

125. Zimmer, H.
 Recording of bioelectronic signals for digital
 computer analysis. In ANNUAL CONFERENCE
 ON ELECTRICAL TECHNIQUES IN MEDICINE
 AND BIOLOGY, 13TH, WASHINGTON, D. C.,
 31 OCT-2 NOV 1960. Digest of Technical
 Papers. p.42.

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